Delivering the Digital Revolution: Will mobile infrastructure keep up with rising demand?

February 2018

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Introduction

It's hard to exaggerate the impact that mobile technologies have had on everything from individual behaviour to the global economy. People not only communicate using mobile devices, they research, buy, bank, conduct business, interact with governments and receive medical care. Entirely new industries and business models, such as the sharing economy, have grown up on the back of digital and mobile technologies.

Little surprise then that GSMA research has shown the mobile economy generating 4.4% of global GDP in 2016—more than $3.3 trillion of added economic value and $200 billion more than in the previous year.[1] The mobile industry will add $4.2 trillion to the global GDP by 2020. The mobile ecosystem also creates jobs. In 2016, the mobile industry and related digital sectors provided employment for more than 28.5 million people worldwide.

Globally, mobile services continue to spread. More than 5 billion people subscribe to a mobile service—more than 60% of the world's population. By 2020, the number of unique subscribers is expected to hit 5.7 billion, 4.7 billion of whom will access the internet from their mobile phone.

With increasing smartphone penetration in developing countries, as well as the rise of ultra-high-definition video and new use cases with high data demand such as augmented and virtual reality, use of mobile services will continue to grow exponentially. Recent forecasts predict that global data consumption will rise at an annual growth rate of 47% over the next few years, resulting in almost five times more demand for network capacity by 2020. Beyond 2020, with growth in connected cars and other emerging technologies and business models, as well as the massive connectivity required for the Internet of Things (IoT), the volume of mobile data traffic can be expected to continue to increase.

Or will it? Suppose the telecommunications infrastructure to support all that growth hasn't been built out. Suppose the high-quality mobile broadband connectivity that is expected to provide the capacity and the capability for high-speed, highly reliable, mission-critical communications falls short? Suppose the mobile revolution slows or even stalls because data traffic slows or stalls—the digital equivalent of a rush-hour traffic jam on a big city multi-lane motorway. Then what?

It's far from an impossible scenario. As the GSMA has observed in past reports, there are five basic enablers of the digital economy: high-speed, reliable and robust broadband infrastructure; digital safety and security; locally relevant content and services; digitally skilled users; and digitally engaged governments and businesses.[2] (See Exhibit 1). They are all essential, but the absence of high-quality infrastructure, much of which needs to be wireless, renders the others moot. Many studies have shown a clear correlation between network quality on the one hand and the degree of digitalisation on the other, which is a particular issue in many emerging markets that have yet to make the transition from 3G to 4G. A slow-down in investment in mobile infrastructure can undermine the continued digitalisation of homes and businesses and the growth of the digital economy with potential implications for consumers, companies and national competitiveness.

1. The Mobile Economy 2017, GSMA
2. Embracing the Digital Revolution: Policies for Building the Digital Economy, GSMA report, February 2017

Exhibit 1

Key enablers of a digital economy

INFRASTRUCTURE	Reliable, fast and ubiquitous telecommunication networks Supporting physical infrastructure (energy, logistics)
DIGITAL SAFETY AND SECURITY	Trust in digital systems, no data misuse Well-functioning cyber-security systems
LOCALLY RELEVANT CONTENT AND SERVICES	Broad choice of local language and locally relevant digital content and services
PEOPLE ABLE TO COPE WITH DIGITALISATION	Broad digital literacy Strong technical, inter-personal and higher-order cognitive skills
DIGITALISING COMPANIES	Broad and proactive adoption of digitalisation by local companies Government and public support for company digitalisation

Source: Embracing the Digital Revolution: Policies for Building the Digital Economy, GSMA 2017

Such a slowdown could be in the cards. To keep up with the ever-growing demand for mobile data and the steep rise of the number of connected devices, mobile network operators in emerging markets need to replace their legacy 2G and 3G technology with at least 4G capability.

In developed markets, mobile operators must manage the transition from first-generation 4G technology to 4.5G/4.9G capability and move forward with the development and deployment of next-generation high-quality broadband infrastructure (often referred to generically as 5G). But even with the advance of next generation technology, as well as efficiency gains and latency reductions from new technologies such as multiple input-multiple output (MIMO) links, beamforming and edge computing, capacity shortages are not easily resolved. The deployment of new technologies is costly, and financial constraints limit the degree to which operators can reconfigure their networks. At the same time, regulations can hinder deployment and drive up costs. With the need for massive small cell deployment in inner cities, regulations in many countries must be reviewed and adjusted as a prerequisite for the ultra-high capacity mobile broadband revolution.

This report examines the requirements for continued deployment of high-quality mobile broadband infrastructure and how to accelerate network investments within appropriately adjusted regulatory frameworks and policies. It focuses primarily on urban areas because cities are where the potential capacity constraints, as well as other barriers to mobile network deployment, are greatest. It asks specifically how policymakers, regulators and network operators can work together to ensure timely and affordable deployment of the new technologies that will keep the digital and mobile economies growing.

The Business Case for Infrastructure Investment

The problem, in a nutshell, is that while data traffic growth soars, the business case for network operators to invest in upgrading mobile networks is weak because operators have only a small share in the value of the projected growth. Revenues for network operators depend on multiple factors, for example, consumer purchasing power, competition intensity, the quality of mobile networks and regulatory frameworks. In terms of new unique users, developed markets are mostly saturated.[3] Subscriber numbers in emerging markets are still growing, but at low average revenue per user (ARPU) levels. Worldwide, research shows that mobile ARPUs have been falling in all regions for many years, even as data volumes have grown exponentially.[4]

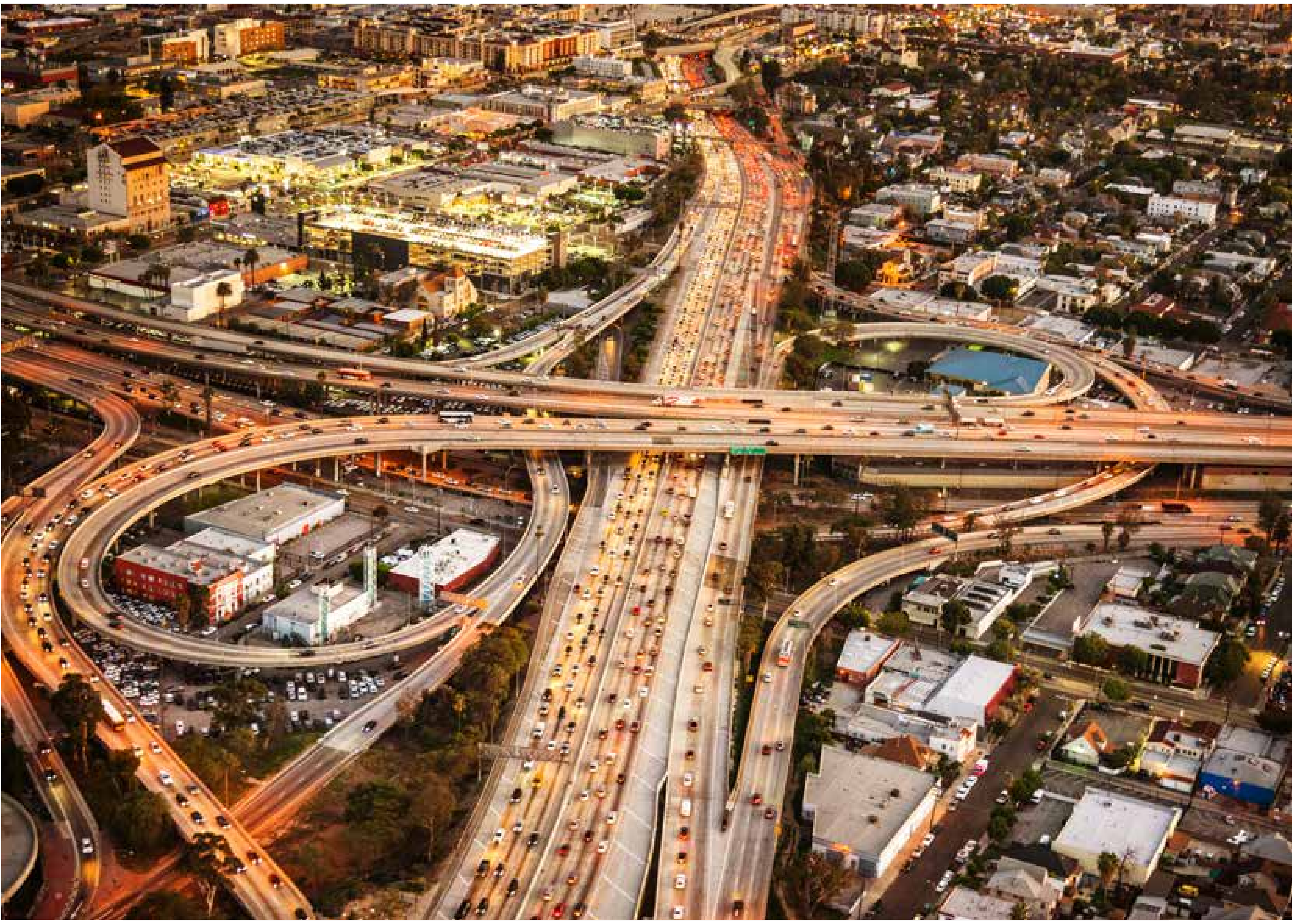
This trend is expected to continue despite the introduction of next-generation, high-quality broadband connectivity. The primary reason is that subscribers historically have not had to pay more for additional services, such as data, when new radio access technologies are deployed, so they see little reason to do so. Previous improvements in technology, such as 3G and 4G, did not bring revenue growth by themselves, and there is no reason to assume that the introduction of a new generation of mobile technology will be different and lead to additional revenues for operators. It also remains to be seen whether end users or content providers will be willing to pay for such new uses as in-vehicle entertainment or augmented and virtual reality. Tariffs with large data allowances are already commonplace in many markets, and it is challenging to adjust such tariff structures.

3. The Mobile Economy 2017, GSMA
4. OVUM/Informa, December 2017

The Cost of Advanced Network Infrastructure

Mobile networks in megacities with large numbers of technology-savvy and relatively affluent users will be first to reach maximum capacity levels. Many, but by no means all, of these cities are in developed markets; Shenzhen and São Paulo face many of the same capacity issues as New York and Tokyo. Fast, widespread deployment of advanced network technologies is necessary to relieve high traffic density (gigabytes per square kilometer) in these dense urban areas.

Different cities require approaches to future network deployments that are tailored to their circumstances, including topology and the extent of existing mobile and fixed infrastructure (particularly fibre-optic networks and energy networks). Economic factors, such as ARPU levels, also play a role. To get a handle on the varying needs of different types of major urban centers, GSMA and BCG analysed the mobile broadband infrastructure needs of the world's megacities, based on their stage of development (defined by GDP per capita) and projected traffic density (defined by gigabytes per square kilometer), using a segmentation originally developed by Shell Oil.[5] The analysis examined four big-city archetypes, each with its own network infrastructure needs and costs. (See Exhibit 2).



5. https://www.shell.com/energy-and-innovation/the-energy-future/future-cities/future-city-archetypes.html

Urban Powerhouse
Examples: New York, Tokyo, Seoul

Developing Mega-Hub
Examples: Shenzhen, Shanghai, Sao Paulo, Mumbai

Sprawling Metropolis
Examples: Paris, London, Los Angeles

Crowded City
Examples: Manila, Lagos, Lima

Exhibit 2

NETWORK DEPLOYMENT VARIES IN FOUR MEGACITY ARCHETYPES

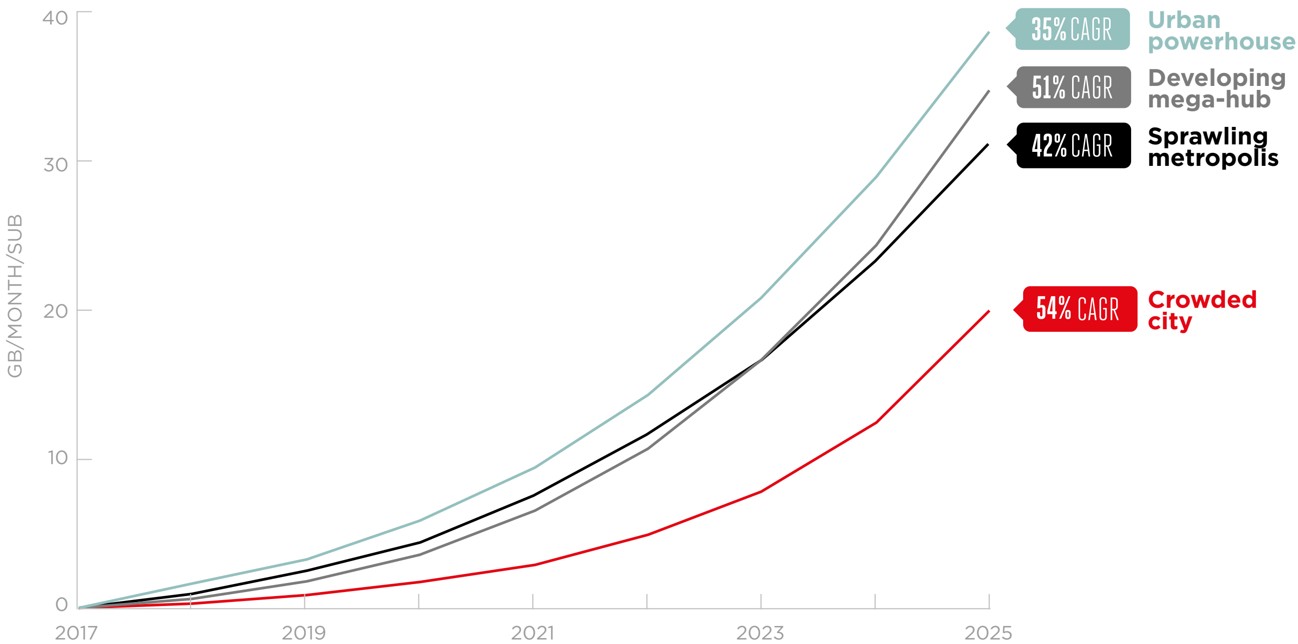
		Lower costs of sites relative to ARPU. **DEVELOPED**	Higher costs of sites relative to ARPU, less developed infrastructure and higher demand growth. **DEVELOPING**
DENSE	Due to limited site-to-site distance and high traffic density, the limitations of the macro network are reached quicker and **more small cells are required**	**URBAN POWERHOUSE**	**DEVELOPING MEGA-HUB**
SPARSE	Due to the lower traffic density, the limitations of the macro network are reached later and **fewer or no small cells are required**	**SPRAWLING METROPOLIS**	**CROWDED CITY**

Note: City archetype definition based on study by Shell.

As a base case and reference for comparisons, forecasts were performed on mobile network development through 2025 for each urban archetype based on a consistent methodology for projecting demand, which is rooted in the current economic and regulatory environment. This methodology was also applied across all city archetypes. Each archetype faces its own growth trajectory in terms of data traffic, with the fastest traffic growth occurring in developing urban areas—developing mega-hubs and crowded cities—for which the projected annual traffic growth will be more than 50%. Urban powerhouses and sprawling metropolises face annual traffic growth rates of more than 35%. Exhibit 3 shows the typical projected growth for a representative city in each archetype.

Exhibit 3

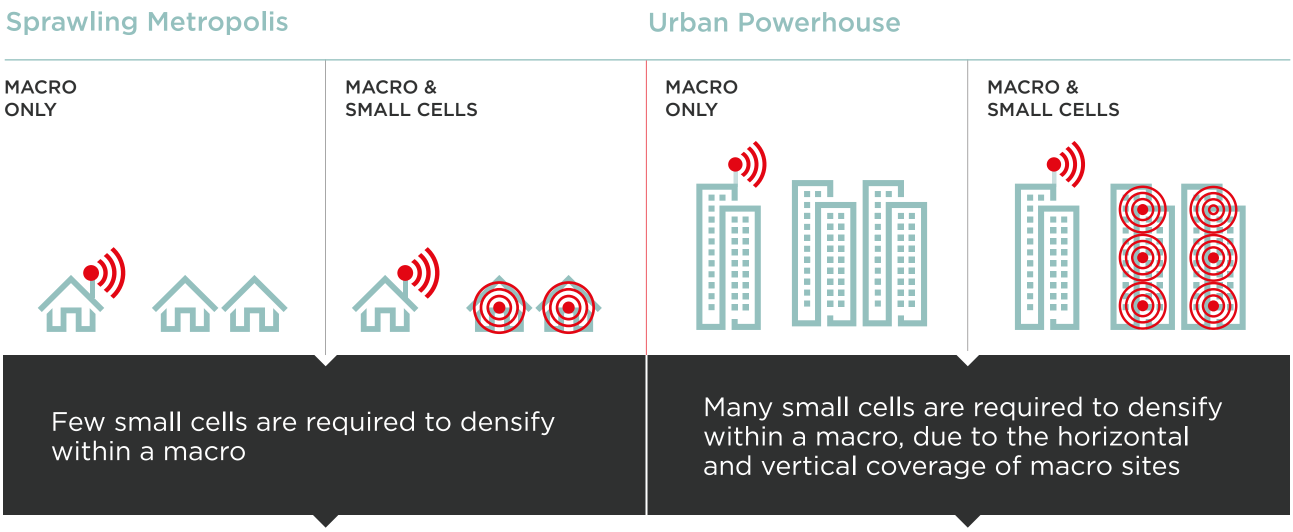
MOBILE DATA TRAFFIC IS EXPECTED TO GROW RAPIDLY WITH A CAGR BETWEEN 35% AND 54% UNTIL 2025



The primary factor affecting the cost of advanced network deployment is dense skyscraper construction in urban powerhouses and developing mega-hubs. These networks require significantly more small cells to densify and increase capacity. In a sprawling metropolis, one building typically can be covered with one, or at most a few, outdoor small cells. In urban powerhouses, the number of small cells required depends on the height of the buildings, since several small cells positioned on various floors are necessary to fully cover the structure. In addition, in dense cities, more small cells will be needed because macro cells reach their geographic saturation point earlier. Further macro cell deployments in highly developed cities are restricted owing to difficulty in obtaining construction permits. (See Exhibit 4).

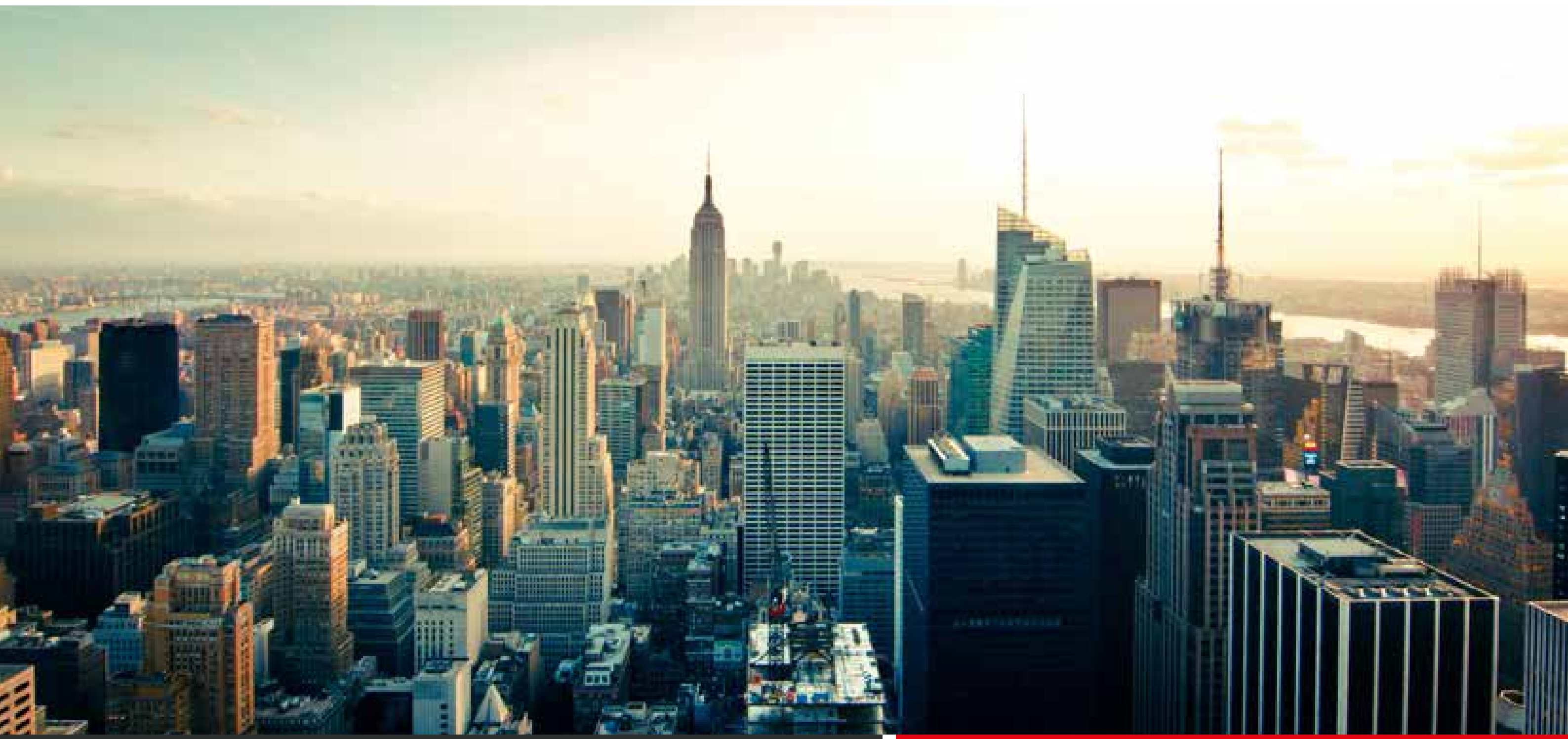
Exhibit 4

SMALL CELL DEPLOYMENT IN DENSE CITIES WITH MANY HIGH RISE BUILDINGS



In the model, the limiting ration of small cells to macros is lower.

In the model, the limiting ratio of small cells to macros is higher.

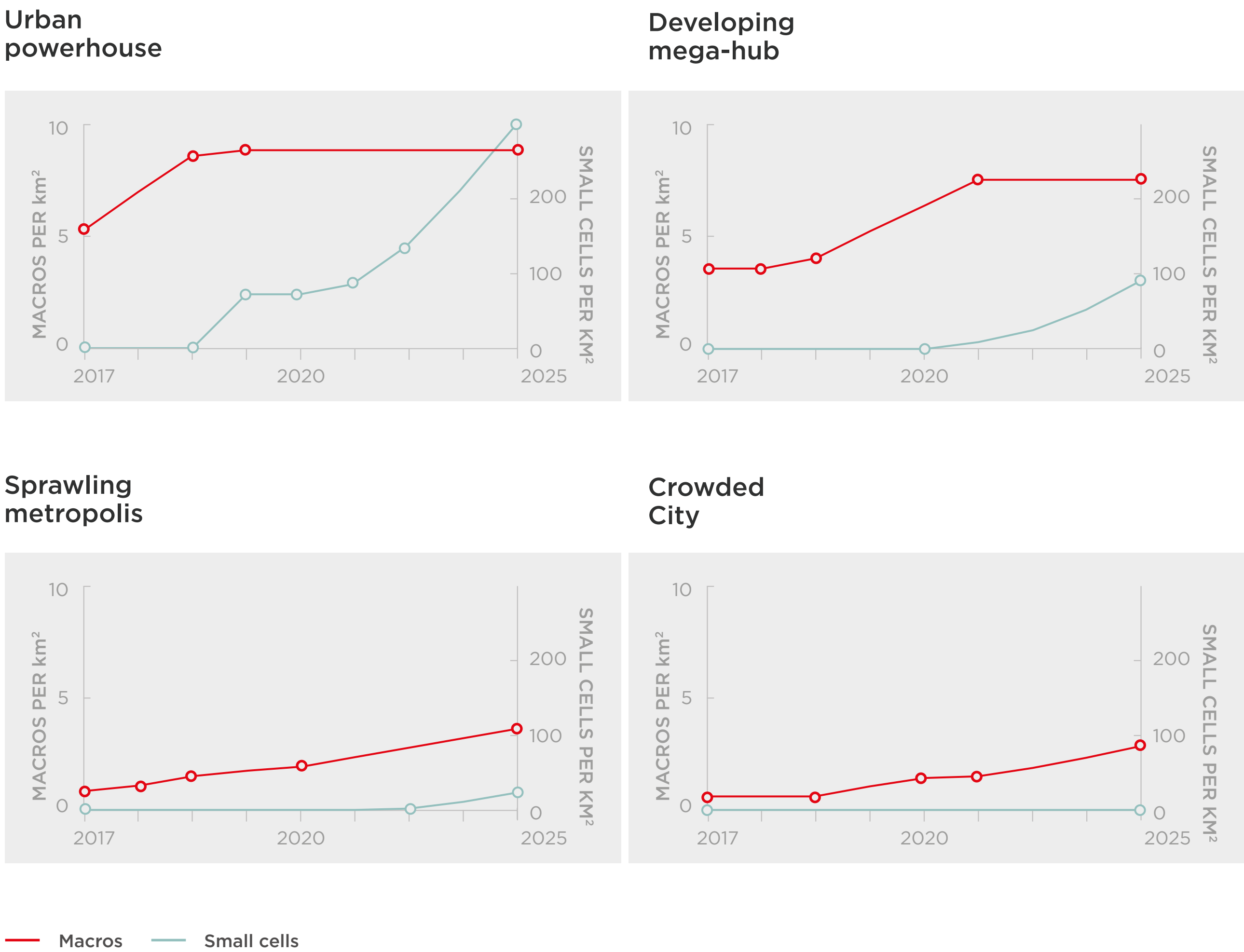


Small cell deployment is expensive. It can take many small cells to match the capacity of one macro cell—as many as 30 times more in urban powerhouses and 10 times more in developing mega-hubs.

At the same time, rents for a single small cell installation are often very high compared to rents for a macro cell. (See Exhibit 5).

Exhibit 5

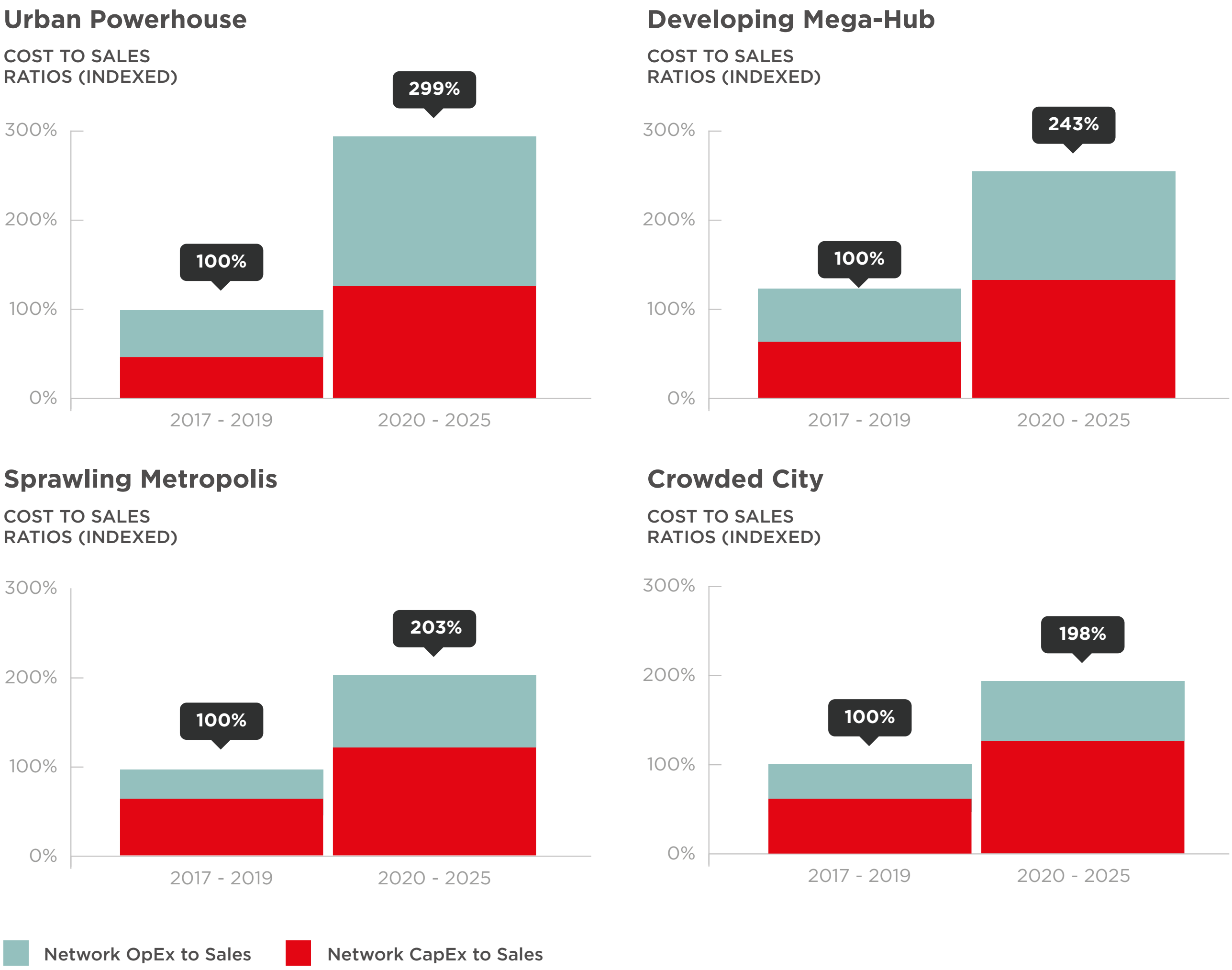
DENSE CITIES REQUIRE MORE SMALL CELLS SOONER – SPARSE CITIES STILL WITH POTENTIAL TO DENSIFY MACRO GRID FIRST



It is estimated that mobile operators' capex and opex costs will triple in urban powerhouse cities by 2025 and double, at least, in each of the other urban archetypes in order to provide sufficient network capacity. (See Exhibit 6). This level of expenditure is financially not feasible—never mind sustainable.

Exhibit 6

DEPLOYMENT IS FINANCIALLY VERY CHALLENGING — OPEX AND CAPEX ARE DOUBLING

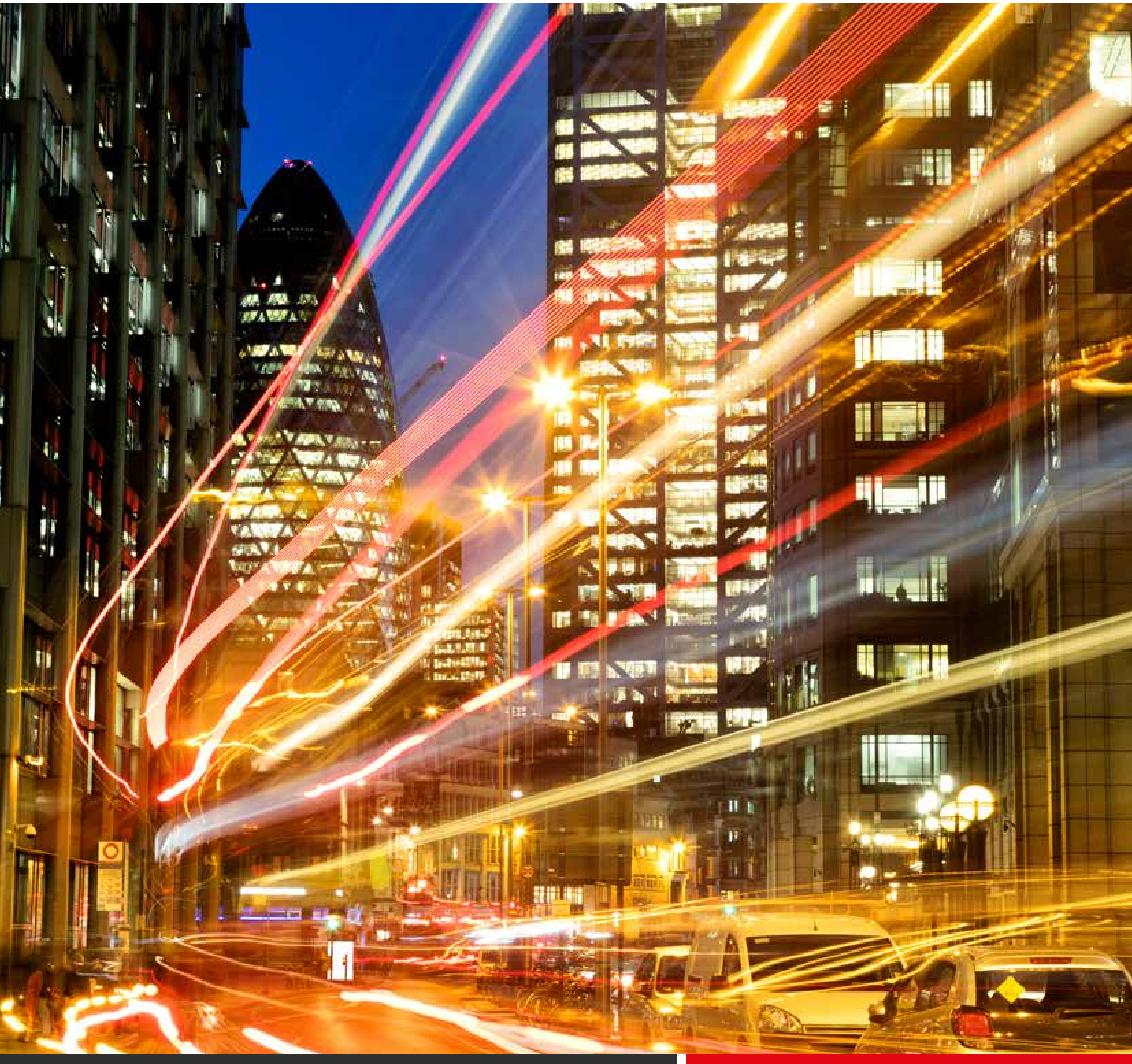


Note: No financial restrictions assumed; indexed figures
Source: BCG

If operators cannot increase their revenues substantially to support huge escalations in capex spending, a significant gap between forecast data-traffic demand and network-capacity supply could open over time. The first cities affected will be those with high traffic densities as they will reach the capacity limits of their macro networks earlier while small cell deployment remains financially restricted. Based on the analysis, in the absence of sustainable business strategies, BCG projects that 45% to 48% of traffic demand could go unserved in ultra-dense urban areas by 2025.

Even in less dense megacities, where further densification on the macro grid is still possible, network capacity will not be sufficient to keep up with the rapidly growing demand. The projected supply-demand gap will be 14% to 21% in 2025 in sprawling metropolises and crowded cities.

It is important to note that the divide between supply and demand will likely continue to increase beyond 2025. This is particularly true for less dense cities, where reaching the limits of macro site densification and the corresponding massive-scale small cell deployment will occur farther into the future.



Policy and Regulation for Infrastructure Deployment

Continued massive traffic growth will bring even the most advanced 4G mobile networks to their limits in just a few years. Will network operators have the incentive to invest in new technologies and network densification? Operators are already cutting costs as part of their normal course of business. They need to explore opportunities for new revenue streams and business models. But policymakers and regulators also have a critical role to play: to unlock the vast economic potential of next generation mobile broadband, they need to revisit their own priorities.

Regulatory policy needs to change with the times. Past policy has focused on incentivising competition and keeping prices low, which has benefited consumers and underpinned development of a competitive market. Today, however, with traffic rising and ARPUs stable or falling, policy making should also consider investment in next-generation infrastructure as an objective to enable further technological advances. A number of areas are ripe for re-examination. For example, policies that maintain an artificially high number of competitors in a given market by constraining consolidation or by artificially incentivising new entrants undermine investment because of the low (or no) expected returns. Spectrum sales that reap billions for governments impede investment by leaving the winning companies in a weakened financial state.

Incentivising investment, furthering technical progress, and improving quality of service and innovation are all important factors for a sustainable telecommunications market on which the digital economy society can thrive. As the impact of digital technologies increase in just about all areas of business and daily life, the importance of these non-price-based considerations rises rapidly as well.

The GSMA has long argued that policymakers and regulators need to take a broader and longer-term view of consumer benefits, looking beyond just price. In most markets, current policy and regulations inhibit investment in advanced mobile infrastructure. In some cases, regulations slow approvals and add cost. In others, they impede, or even block, deployment of new macro cells and small cells. There are six areas identified which relate to network deployment in which a re-think in policy or regulatory reform can remove current constraints and foster investment in infrastructure for high-quality broadband. (See Exhibit 7).

Exhibit 7

REGULATORY LEVERS TO FOSTER NEXT GENERATION DEPLOYMENT

- Additional, affordable spectrum
- Facilitate deployment of front and backhaul infrastructure
- Access to advantageous (macro and small cells) site locations
- Freedom to establish network sharing agreements
- Enable small cell deployment
- Harmonised power density limits (PDL)

Additional, affordable spectrum

Spectrum is the scarce resource that the mobile communication network is built on. It has been argued many times before, making additional spectrum available in a timely fashion—and at affordable prices—is a top priority for accelerating advanced network deployment. The analysis indicates that new and affordable spectrum could bring down capex and opex costs significantly in each of the city archetype analysed.

Many governments around the world have initiated, scheduled, or at least planned, spectrum auctions related to the bands slated for 5G deployment, e.g., 3.4–3.8 GHz or 28 GHz. A few governments provide models for how to set policies that build a "spectrum roadmap"—a well-planned and transparent process for spectrum release, which enables network operators to plan their own futures more effectively.

Early release is only one aspect of constructive, enabling spectrum regulation. Policymakers also have to strike an appropriate balance among sometimes competing objectives, such as maximising proceeds from spectrum auctions, fostering competition to keep consumer prices low, and enabling build-out of new mobile broadband infrastructure. In some cases spectrum auctions to date have been designed to further the first two objectives at the expense of making sure funds are available for infrastructure construction. One lever that policymakers and regulators can pull is making additional spectrum available at fair, affordable prices that incentivise fast network investment and deployment post auction.

Facilitate deployment of front and backhaul infrastructure

To avoid bottlenecks and capacity constraints—and performance issues for customers—high-capacity macro cells and small cells need to be connected to the backbone network via fibre-optic cables and microwave links. Fast, high-capacity connections are especially important for enhanced mobile broadband, fixed wireless access, and services that require low latency (such as remote-controlled robotics). But fibre connections are expensive, they take a long time to build, and right of way permits are difficult to obtain. Newer players and mobile-only operators are particularly disadvantaged since they have little fibre in their networks compared with incumbents and integrated operators. Changes that facilitate the roll-out of new fibre front and backhaul lines and encourage sharing of facilities, backhaul and infratructure construction costs, can help to reduce overall costs.

Access to advantageous (macro and small cell) site locations

Illustration 1

In addition to operational challenges, operators often face significant hurdles in acquiring new site locations. One is cost. New sites, especially locations for small cells, come at steep rents, making large-scale deployments nearly impossible from a financial perspective. Another issue is access. Historic buildings and public infrastructure, such as municipal buildings, are sometimes excluded from consideration.

Granting access to public buildings and street "furniture," such as bus-stop shelters and lamp posts, owned by municipalities, at low or no cost would remove a significant hurdle to cell deployment. Moreover, new street infrastructure, with some financial support from network operators, could be manufactured and installed deployment-ready so that operators could immediately attach their equipment and connect to backhaul and energy networks (See Illustration 1). Such subsidised and rent-free deployments are an investment in the countries' infrastructure needs and economic development.

Singapore provides a good example of effective regulation that facilitates affordable access to site locations for both macro sites and small cells.

In its COPIF (Code of Practice for Info-Communication Facilities in Buildings) review, it has adopted a regulation requiring building owners to provide in-building "mobile deployment spaces", including pre-installation of fibre endpoints, expressly for the installation of infrastructure to enhance mobile coverage and capacity.[6] This applies to both existing and new developments. It has set an important precedent and already led to a much-needed cost-efficiency boost for network densification. Further amendments to the COPIF are currently under discussion to extend the provision of mobile deployment spaces to roof-tops and to make roof-tops rent-free.[7] Such an extension would enable even more investments at affordable costs and can be seen as a first step towards similar regulations for outdoor small cell siting, where high rental costs usually render large-scale deployments financially unfeasible.

6. Code for Info-Communication Facilities in Buildings, iDA, InfoComm Development Authority of Singapore, May 2013, https://www.imda.gov.sg/-/media/imda/files/regulation-licensing-and-consultations/frameworks-and-policies/interconnection-and-access/idas-requirements-to-be-included/code-of-practice-for-infocomm/04-copif-2013.pdf?la=en
7. Public Consultation on the Review of the Code of Practice for Info-Communication Facilities in Buildings, InfoComm Media Development Authority, April 2017, https://www.imda.gov.sg/-/media/imda/files/inner/pcdg/consultations/consultation-paper/copif-review---consultation-paper.pdf?la=en

Freedom and incentive to establish network sharing agreements

The massive number of small cells required in the future will put an enormous capex and opex burden on mobile operators. Operators are, therefore, considering sharing small cell networks to bring down each company's costs. In many markets, however, such cooperative agreements run into regulatory roadblocks. Network operators need the flexibility to establish sharing agreements for mobile networks, including for fronthaul and backhaul. From an urban planning perspective, effective regulation also can help control the number of sites adding to visual pollution.

Regulators can even take steps to encourage shared small cell deployment. For example, operators could be incentivised to prepare small cell locations to be in a manner similar to the deployment-ready installation of light poles, described in the previous subsection. Such a regulatory reform is currently under consideration in the US.

The Broadband Deployment Advisory Committee (BDAC) to the Federal Communications Commission (FCC) has recently drafted recommendations to make location sharing for small cells less costly by avoiding double recovery of capital costs. So-called "make-ready" costs, which are paid to pole owners to prepare poles for small-cell deployment, would only be charged once (for the first operator attaching a small cell to the pole) and could not be charged again in the future. This both enables and encourages operators to co-locate their small cells. Such regulatory reforms could also be extended to rent payments, ensuring that site owners charge proportional rents when multiple operators use the same pole.

8. FCC, p.4, https://apps.fcc.gov/edocs_public/attachmatch/DOC-347451A1.pdf

Enable small cell deployment

Cumbersome bureaucratic approval processes typically inhibit timely large-scale deployment of small cells. Regulators can facilitate next-generation infrastructure investments by streamlining their approval processes.

Possible mitigation measures include:

- Simplified, transparent and standardised application and review processes for small cell siting
- Exempting small cells that meet certain set criteria from reviews of environmental and historic site preservation organisations
- Accepting declarations of compliance for MNOs without requiring routine post-installation measurement of power density

In the US, the BDAC has recently approved recommendations for standardising the new siting application process. The recommendations include:

- Simplified application process. The BDAC recommends that a standardised siting application form be adopted by all federal landholding or managing agencies with a single, clear point of contact for application review and follow-up. Ideally, an easily accessible online tracking mechanism for application status should be established.
- Loosening of approval criteria. The advisory committee recommends a harmonised process for environmental assessment to make approval and denial criteria more transparent. At the same time, exclusions from the National Environmental Protection Act and the National Historic Preservation Act should be further streamlined.
- Introduction of "shot clocks." After receiving an application, authorities have to inform applicants of any additional required material within 10 days and review the application within 60 days. Absent action to the contrary, applications for new installations would be approved after 180 days, and applications for relocation would be deemed approved after 90 days.
- More transparency for calculation of fees. Local authorities should be required to make fee schedules publicly available.[9, 10]

9. https://www.fcc.gov/broadband-deployment-advisory-committee
10. Broadband Deployment Advisory Committee: Streamlining Federal Siting Working Group, Amended Final Report, Nov. 9, 2017, https://www.fcc.gov/sites/default/files/bdac-federalsiting-11092017.pdf

While the aforementioned initiatives are still awaiting action, it is a clear positive sign for the US that the debate over facilitating small cell deployment has started on the national level and that the FCC is trying to ease regulatory burdens on mobile network operators.

Local authorities have the final say on the specific implementation of many regulations in the US. Some cities have already passed progressive bills to facilitate small cell deployment.

Based on a Texas state bill that took effect in September 2017, the cities of San Antonio and El Paso have passed regulation simplifications for small cell deployment on municipality-owned poles, including standardising the application process, providing transparent criteria for approval and denial, and establishing shot clocks for the application process. If implemented successfully, these reforms could lead to large-scale cost savings for operators and, more importantly, enable timely deployment of new technologies. The success of regulatory reform in such pioneer cities may lead others to follow.

Harmonised power density limits based on WHO and ICNIRP recommendations

Protecting public health and safeguarding the environment from exposure to levels of radiofrequency electromagnetic field (RF-EMF) above recommended limits is an important consideration during the rollout of next-generation mobile infrastructure. An independent organisation, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), defined power density limits (PDLs) in 1998, and these limits have been endorsed by the World Health Organization (WHO).[11,12] The limits were reconfirmed in 2009 and 2017. They are currently under review with a draft for public comment expected in mid-2018.[13,14] ICNIRP indicates that the anticipated exposure-limit changes are very small compared with the large degree of precaution that was built into the 1998 guidelines. While most countries have adopted the ICNIRP exposure-limit recommendations, some continue to apply limits that are 10 to 100 times more strict (including Italy, Bulgaria, Poland and Switzerland in Europe).[15] These increase costs of network deployment and make it more difficult to share existing sites.

Overly strict PDLs undermine the ability of policymakers, regulators and MNOs to speed up deployment of next-generation infrastructure in all of the areas described above. Radio spectrum cannot be effectively used and, therefore, goes to waste. New mobile technologies, such as massive MIMO, cannot be deployed, negating the value of technology advances. New sites or colocations are rendered unavailable for deployment. Regulators should re-examine their positions and seek to harmonise limits with others and with WHO and ICNIRP recommendations.

11. http://www.icnirp.org
12. EMF Guidelines (1998): http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf; experimentally and computationally derived limits, safety factor of 50 applied for the general public, resulting in 200 [W/m2] for frequencies between 400 MHz and 2 GHz and 10 [W/m2] for frequencies between 2 GHz and 300 GHz
13. High-frequency electromagnetic fields (100 kHz-300 GHz) – review (2009): http://www.icnirp.org/en/publications/article/hf-review-2009.html and Statement on EMF Guidelines (2009): http://www.icnirp.org/cms/upload/publications/ICNIRPStatementEMF.pdf
14. http://www.icnirp.org/en/activities/news/news-article/revision-of-hf-guidelines-2017.html
15. Ministry of Environment (2003): http://isap.sejm.gov.pl/Download?id=WDU20031921883&type=2

Lowering Network Costs to Meet Rising Data Demand

Taken together, reform in the six areas described can go a long way toward reducing operators' capex and opex costs and thereby close the projected supply-demand gap between now and 2025. GSMA and BCG estimate that the combined levers of regulatory reform could cut costs by approximately 30% to 50%, depending on the city archetype. The biggest percentage cost savings come in urban powerhouses and developing mega-hubs where demand is rising the fastest and where the operators face the biggest challenges to new infrastructure investment (See Exhibit 8).

Exhibit 8

PROPOSED REGULATORY LEVERS LOWER NETWORK COST ALMOST TO SUSTAINABLE LEVEL

With access to additional spectrum, operators can increase the capacity of their networks by deploying additional bands on their existing infrastructure. This reduces the need for densification leading to substantial cost savings. Even with the release of additional spectrum, there is still an urgent need for small cell densification, and without regulatory relief, disproportionately high costs lead to significant opex increases for network operators.

Looking at a time horizon beyond 2025, all city archetypes will ultimately run into capacity problems that cannot be solved by macro site densification alone. Moreover, spectrum made available after 2025 to a large extent will be in the mmWave regime, and deployment on macro sites will be not be feasible. Not making much-needed regulatory reforms now will at best delay such problems and, in the worst case, slow or constrain investment. Even in sprawling metropolises and crowded cities, operators often build dense small cell layers in inner cities for strategic reasons, such as providing better quality of service in busy areas. Such investments can have a lasting positive impact on the digitalisation process and should not be hindered through outdated policies.

Regulatory Reform Is Difficult but Necessary

Alleviating capacity constraints and advancing digital capabilities requires investment in next generation infrastructure. Changing regulation, however, is never easy. Policymakers and regulators find themselves in the challenging position of striking a balance that serves the interests of many stakeholders.

Citizens want high-quality networks at low prices. Governments focus on maximising proceeds from spectrum auctions and a strong, but also a competitive, telecommunications sector as a main enabler of a mobile digital community. Network operators need incentives to make the business case for investing in next-generation high-quality broadband infrastructure.

Finding the right mix is hard, and it can be a lengthy process, often requiring several rounds of consultation with individual stakeholders until fair compromises are achieved. That said, the rapid transition to a global mobile and digital society isn't slowing down. If network operators, regulators and policymakers can work together to achieve the improvements in efficiency and effectiveness described above, operators can be counted on to build the infrastructure of the future. While they may still need to shoulder increases in network opex and capex, they will also have business opportunities enabled by new technologies and capabilities to recoup these costs. A productive regulatory environment that encourages investment just as it incentivises competition can also be a deciding factor in the transition to a more mobile and digital society.

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